AN INTERIM NOTE

ON

SOUTHERN HEMISPHERE CLIMATOLOGICAL GRID DATA

by

Roy L. Jenne*

Harold L. Crutcher**

Harry van Loon*

J. J. Taljaard***

* National Center for Atmospheric Research
Sponsored by the National Science Foundation
Boulder, Colorado

** Department of Commerce
Environmental Science Services Administration
Environmental Data Service
National Weather Records Center
Asheville, North Carolina

*** Weather Bureau
Republic of South Africa

September 1969

Introduction

This writeup on the content and format of a climatological tape for the southern hemisphere will become a part of the referenced technical note to be published by the National Center for Atmospheric Research (NCAR). In it we will also discuss the computer methods used, and will give an inventory of a set of microfilm data which will then be available. This interim note has been written to permit earlier use of the grid point data.

Production of the analyses on which these grid point values are based resulted from a merger of efforts at the National Center for Atmospheric Research, sponsored by the National Science Foundation, at Boulder, Colorado and the Environmental Science Services Administration, Environmental Data Service, National Weather Records Center (NWRC), Asheville, North Carolina. These are support material for an investigation of the atmospheric circulation of the southern hemisphere undertaken at NCAR.

The basic analyses and selected derived products are being published in four volumes of an atlas covering selected climatic conditions in the southern hemisphere. Volume I gives mean monthly isopleth charts of sea-level pressure and of height, temperature and dew point at selected upper levels, together with smoothed grid-point values produced by computer analysis from these charts. Volume II will deal with geostrophic zonal and meridional wind components, Volume III with isogons and isotachs of the geostrophic wind, and Volume IV with selected meridional cross sections of temperature, dew point and isobaric height.

The basic analyses were for all seven levels through 100 mb for the four seasonal months of January, April, July, and October. For the other eight months analyses were only made at sea level, 500 mb, and 200 mb.

The analysis procedures are discussed in Volume I of the atlas. Later on, the other 100 mb height maps were also hand-drawn. The computer derivation of the other intermediate month grids and of the various derived grids will be discussed in the technical note.

Data Availability and Format on Magnetic Tape

We will now discuss the content and format of a magnetic tape that has grid-point data for the basic southern hemisphere analyses and for many derived quantities such as geostrophic winds and surface pressure. The grid used has points each 5° of latitude and longitude. We will describe both the binary floating point format of the grid-point data and the BCD format that is available for purchase.

When information that pertains to height, temperature, or dew points is used for publication, Volumes I and IV of the atlas should be referenced; for winds, please reference Volumes II and III. If one user copies the data tape for another, we request that a copy of the writeup be sent with the tape and that we are notified of the transfer. In this way we can keep an up-to-date mailing list of the major users of the data.

We caution the reader again that grid-point values of geostrophic winds near the equator may differ appreciably from real winds, and that grid-point values under the antarctic ice cap are not meaningful, but are included to provide reasonable continuity in the grids. Also please refer to the section on problems remaining in the grids for further comments on analysis problems.

A similar data tape is available for the northern hemisphere. The winds given at the equator are the same on both tapes. The unsmoothed hand-analyzed height grids are the same at the equator; but since the northern heights have been time smoothed, there are some differences in the processed grids. The match between the respective hand-drawn temperature (and dew point) grids for the two hemispheres should be very close at the equator. The differences may be somewhat larger where the southern hemisphere grid was derived by computer methods.

Data Order on the Tape (NCAR tape TL566 and its duplicate TL599)

Item	Types	#grids	nform	Description
1	6,1	91	85 or 84	Sea level pressure plus height grids for levels 850, 700, 500, 300, 200, 100 mb. The grids were horizontally smoothed. Some intermediate month grids were not 'hand' analyzed but were computer derived. (The number of grids is 7 grids/month times 13 months.)
2	3,4	143	85 or 84	Temperature and dew point. Temperature for surface thru 100 mb; dew point, surface thru 500 mb. Surface is not smoothed. Levels above surface were horizontally smoothed. A number of the intermediate month grids were not hand analyzed but were computer derived; the methods are described elsewhere. (11*13 grids)
3	16,17,18	273	85,84	Geostrophic U, V, total winds (m/sec) derived from grids in item 1 above. These winds were then time smoothed and then horizontally smoothed with a simplified smoothing program that had no polar area grid transformation. The special calculation of the winds at the equator, 5S, 10S, and the pole is described elsewhere. (21*13 grids)
4	50,51,52	39	85,84	Surface pressure, pressure from dry air, pressure from water vapor. Calculated from grids in items 1, 2, 9 and from the tropopause pressure and temperature in item 8.
5	53,54	26	85,84	Daily standard deviations by months for the IGY period for sea-level pressure and 500 mb height. Based on 18 months of data. Grids for the same months were averaged when available, and then the 12 grids were time smoothed followed by a horizontal smoothing pass.
6	55,56	26	85,84	Daily RMS changes by months for the IGY period for sea-level pressure and 500 mb height. Shows the 24-hour changes. The data were grouped and smoothed as in item 5.
7	91	12	85,84	Showalter stability index calculated from the mean monthly values in item 2.

Item	Types	#grids	nform	Description
8	10,11,12	108	85,84	Calculated virtual temperature at sea level thru 100 mb and tropopause pressure and temperature from the pressure and height grids in item 1. (9*12 grids)
9	97,98	4	85,84	Geography. Type 97 is elevation of the earth's crust. Thus it gives the depth of the oceans and the base of the icecaps. Code 98 gives the normal elevation data, thus 0 over water and the elevation of ice or earth over land. All values represent an average value for a 5^{o} latitude-longitude square centered about each grid point. If the month code is 1, the data is for the northern hemisphere; 2 is for the southern hemisphere.
10	6,1	60	75	Sea-level pressure and height grids. Same as item 1 only before smoothing. The other 24 grids plus the annual means in item 1 were derived by computer methods.
11	3,4	76	75	Temperature and dew point temperature grids. Same as item 2 only before smoothing. The surface grids include some "mountain" corrections where the original temperature represented a mountain peak temperature rather than the surface temperature at an average elevation. The surface grids are identical to the corresponding grids in item 2. This contains only the hand analyzed maps; these were not drawn for all months at all levels.

Tape Format in Floating Point Binary

The above analyses are available for use at NCAR in a binary format. They can be read on the CDC 6600 with the following Fortran read statement:

```
Read tape Jtape, nform, ntype, level, month,
     ((Y(I,J),I=1,72),J=1,19)
```

where:

nform = 85 or 84 for the processed and derived grids.

= 75 for all of the original hand-analyzed grids after mechanical and mountain corrections were made, but before smoothing. These grids are on the tape after all of the other grids.

ntype = code giving type of data:

6	Sea-level pressure (mbs)
1	Heights (m)
3	Temperature (degrees C)
4	Dew point temperature (degrees C)
16	Geostrophic U wind (m/sec)
17	Geostrophic V wind (m/sec)
18	Geostrophic total wind (m/sec)
50	Surface pressure (mbs)
51	Portion of surface pressure due to dry air (mbs)
52	Portion of surface pressure due to water vapor (mbs)
53	Daily standard deviations of sea-level pressure by months (mbs)
54	Daily standard deviations of height by months (m)
55	Daily RMS changes of sea-level pressure changes by months (mbs)
56	Daily RMS changes of height by months (m)
91	Showalter stability index from monthly means
10	Virtual temperature calculated from height grids
11	Tropopause pressure calculated from height grids
12	Tropopause temperature calculated from height grids
97	Elevation (depth) of the earth's crust (not ice)
98	Normal elevation data of ice or land (the ocean is zero)

level = the level of the data in millibars. The number 1013 is used for sea level, 1001 is used for surface, 1002 is used for depth data, and 5 is used for the tropopause.

month = 1 through 13, where 13 is an annual mean value.

I = 1,72 is 0°W through 355°W, each 5°

J = 1,19 is 0°S through 90°S, each 5°

There is an end of file at the end of the data.

All 72 south pole data points are identical, except in the case of the winds for which the velocity vector is rotated with the longitude to define a wind having the same direction sense as other winds at that longitude.

Tape Format in BCD

The same grid point information may be purchased in BCD form on magnetic tape by writing to the Director, National Weather Records Center, ESSA, Asheville, North Carolina 28801.

In this format, the data for one longitude from equator to pole has been encoded into one logical record in BCD as follows:

```
      Encode (130,910,Nbuf) nhem, nform, ntype, level, month, Ilon,
             (Ival(I),I=1,19),nine

  910 Format (I1,I2,I2,I4,I2,I3,19I6,I2)
```

In this statement 130 characters are encoded into an array called NBUF according to the format statement where:

nhem = 2 for southern hemisphere
     = 1 for northern hemisphere

nform,ntype,level,month: refer to the writeup of the binary format.

Ilon = 0 through 355 for 0°W through 355°W.

Ival = the 19 values from equator to pole. All values have been multiplied by 10, so the units are now tenths of millibars, tenths of degrees, tenths of meters/second, and tenths of meters.

nine = the constant 99 is coded here to provide the user with some check on his tape read and formatting program.

These logical records with 130 characters each are blocked in groups of 18 on the tape, so that there are four physical records for each grid map. At the end of each physical tape record there are 24 extraneous bits which should be ignored except for determining block size.

There is an end of file at the end of the data.

A few data values on the tape are provided for program checkout.

Grid Number	form	type	level	month	0S 0W	70S 245W
1	85	6	1013	1	1010.6	991.6 mb
9	84	1	850	2	1498.1	1199.5 m
98	85	3	500	1	-5.8	-32.3 °C
268	85	16	300	2	-2.6	8.2 m/sec
517	85	50	1001	4	1010.7	707.3 mb
719	85	97	1002	2	-4626.0	540.8 m
858	75	4	500	12	-14.8	-40.4 °C

Problems Remaining in the Grids

In the set of microfilm data (not yet available) we provide a number of plots (see Fig. 11) for selected grid points that show the time continuity of data for the seven pressure levels. Other graphical data and comparisons between grid data and station data are also included to help the reader assess the quality of the analyses. In this section we will comment on some of the problems in the analyses.

At the upper levels we have analyzed for Christmas Island (2°N 157°W) heights about 30 to 50 m higher than the reported values. This whole area needs to be restudied, especially since the data from the 1967 Line Islands experiment agrees with the older statistics.

To give a better fit to observed winds, the geostrophic winds at 5°S and 10°S are calculated using a Coriolis parameter valid at 15°S. The winds at the equator are set equal to .6 (winds at $5^{\circ}N + 5^{\circ}S$) - .1 ($10^{\circ}N + 10^{\circ}S$), subject to the restriction that they do not differ from the average of the $5^{\circ}N$ and $5^{\circ}S$ winds by over 1.5 m/sec. These winds can still be poor approximations to the real winds.

The winds for Recife, Brazil on the November 200 mb chart were originally plotted from the NW instead of from the correct SW. Thus the trough was drawn on the west side of Recife instead of the east side. This has been corrected on the published maps, but not in the grid-point values.

At Port Stanley, Falkland Islands the heights for the 850 through 200 mb levels increase about 30 to 40 m from June to July, decrease to the lowest value in August and then increase again. (See Fig. 10 from the microfilm data.) This "July hump" is a real feature for several individual years at Port Stanley and at other stations in the vicinity. However, judging from the lack of such a hump in the longer term surface pressure data, and from some previous upper air data for Stanley not in our nine-year sample, the hump should at least be smaller for a longer record. Our grid data reflects this July hump (see Fig. 11).

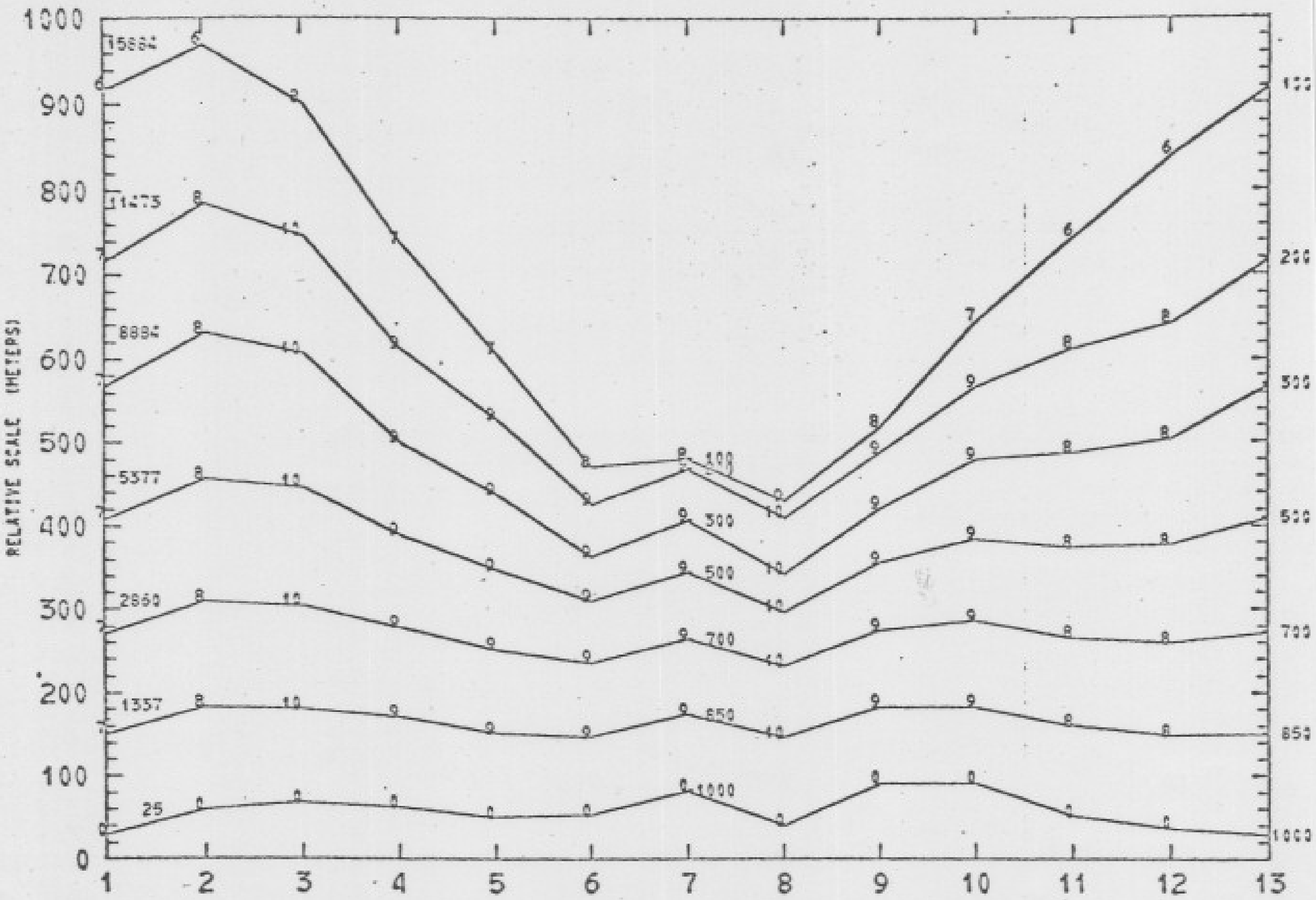
Near $20^{\circ}S$ $120^{\circ}W$ there are errors of up to 80 m in the 200 mb analyses for June through September. Various other more minor problems can be noted in the microfilm continuity plots that have been mentioned.

The analyses do not fully account for radiation correction problems which can be as high as about 60 m for daytime soundings at 100 mb. McInturff and Finger discuss this problem.

HEIGHT CURVES VS MONTH

THE NUMBER OF YEARS OF DATA IS WRITTEN ON THE CURVES
HEIGHTS AND STANDARD DEVIATIONS ARE WRITTEN BELOW CHART

88890 STANLEY, FALKLAND ISLAND LAT 5142S LON 05752W 51M

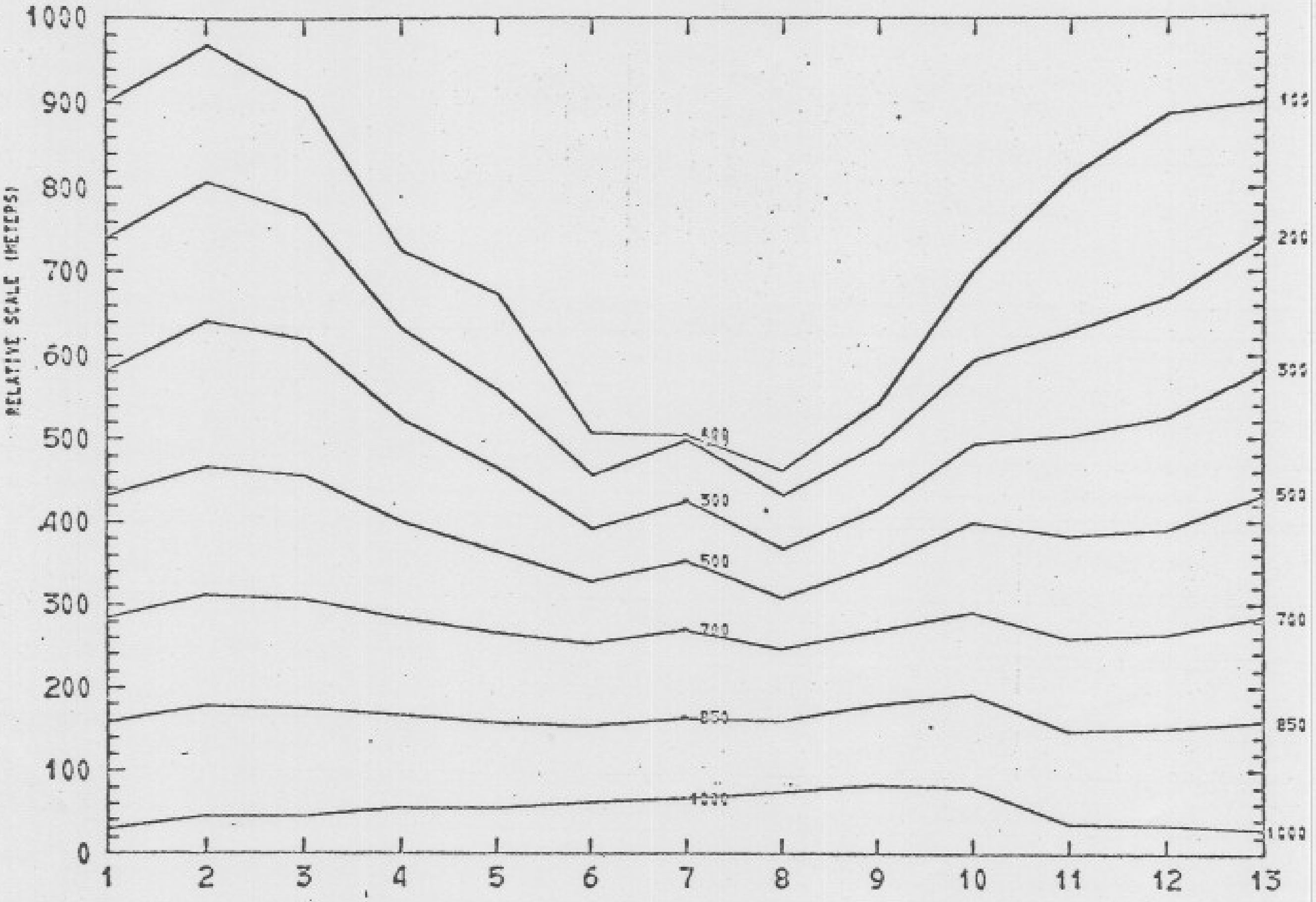


MONTH LEVEL	1	SDV	2	SDV	3	SDV	4	SDV	5	SDV	6	SDV	7	SDV	8	SDV	9	SDV	10	SDV	11	SDV	12	SDV
100	16114	46	16165	70	16097	42	15933	97	15801	62	15666	86	15675	59	15625	76	15714	46	15840	125	15940	89	16035	70
200	11606	66	11676	90	11650	76	11502	111	11417	51	11314	69	11357	41	11299	62	11377	53	11456	105	11501	54	11531	65
300	8975	71	9057	103	9013	83	8906	117	8842	49	8767	55	8811	43	8748	57	8826	52	8865	98	8892	54	8938	62
500	5411	50	5460	69	5450	60	5392	85	5349	40	5312	39	5346	33	5300	44	5358	39	5387	71	5377	48	5379	44
700	2853	35	2901	40	2895	45	2869	58	2842	30	2827	28	2855	29	2825	37	2866	31	2877	51	2857	40	2850	28
850	1323	26	1336	33	1354	38	1343	46	1324	27	1319	24	1346	28	1319	36	1356	30	1366	41	1335	34	1321	20
1000	-5	0	25	0	34	0	28	0	16	0	19	0	48	0	7	0	57	0	57	0	17	0	3	0

Fig. 10. This plot shows the variation with time of pressure-height data at Port Stanley. The pressure level for each curve is given near the July and month 13 (Jan) values. The yearly average is given near the left side of the chart. The numbers of year-months of data going into each mean value are given on the curves. The numbers are zero on the 1000 mb curve because those data were derived by downward extrapolation from the data above. The table gives the actual mean values and their monthly standard deviations.

HEIGHT CURVES SOUTHERN HEMISPHERE

PLOTS VS MONTH FOR LAT 50 LON 60 W



MONTH	1	2	3	4	5	6	7	8	9	10	11	12	AVE
100	16163	16231	16169	15987	15935	15769	15766	15724	15804	15964	16075	16150	15978
200	11676	11744	11705	11569	11496	11392	11434	11369	11428	11531	11565	11604	11543
300	9053	9092	9071	8974	8916	8842	8876	8817	8866	8944	8954	8976	8947
500	5466	5501	5491	5454	5393	5363	5306	5343	5382	5433	5417	5425	5420
700	2899	2926	2922	2899	2881	2867	2803	2861	2833	2905	2873	2877	2890
850	1362	1372	1363	1361	1352	1348	1357	1354	1373	1395	1342	1344	1359
1000	6	20	21	31	32	39	43	50	59	57	13	12	32

Fig. 11. This plot shows the variation with time of the heights from our analyses at a grid point near Port Stanley. The grid-point values are printed below the chart. Sea-level pressure is converted to 1000 mb height by assuming a change of 8.2 m for each millibar.

References

Crutcher, H. L., R. L. Jenne, J. J. Taljaard, and H. van Loon, 1970: Climate of the upper air; Part I Southern Hemisphere; Vol. IV; Selected cross sections of heights, temperatures, dew points and geostrophic winds. NAVAIR 50-1C-58. Commanding Officer, Naval Air Tech Services Facility, Philadelphia, Pennsylvania, in press.

Jenne, R. L., H. L. Crutcher, H. van Loon, and J. J. Taljaard, 1970: Climate of the upper air; Part I Southern Hemisphere; Vol. III; Geostrophic winds. NAVAIR 50-1C-57. Commanding Officer, Naval Air Tech Services Facility, Philadelphia, Pennsylvania, in press.

___________, H. L. Crutcher, H. van Loon, and J. J. Taljaard, 1969: A selected climatology of the southern hemisphere: computer methods and data availability. Technical Note. National Center for Atmospheric Research, Boulder, Colorado, U.S.A., in press.

Taljaard, J. J., H. van Loon, H. L. Crutcher, and R. L. Jenne, 1969: Climate of the upper air; Part I Southern Hemisphere; Vol. I; Temperatures, dew points, and height at selected levels. NAVAIR 50-1C-55. Commanding Officer, Naval Air Tech Services Facility, Philadelphia, Pennsylvania, in press.

van Loon, H., J. J. Taljaard, R. L. Jenne, and H. L. Crutcher, 1969: Climate of the upper air; Part I Southern Hemisphere; Vol. II; Zonal and meridional geostrophic wind components. NAVAIR 50-1C-56. Commanding Officer, Naval Air Tech Services Facility, Philadelphia, Pennsylvania, in press.

McInturff, Raymond M. and Frederick G. Finger, 1968: The Compatibility of Radiosonde Data at Stratospheric Levels over the Northern Hemisphere. ESSA Technical Memorandum WBTM-DATAC 2. Environmental Science Services Administration, Weather Bureau, Silver Spring, Maryland.